“Consumerism” and environment: does consumption behaviour affect environmental quality?*

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Abstract

The literature has typically expressed environmental quality as a function of per capita income ignoring the role consumption choices can play as a potential mediating factor between environmental degradation and economic growth. Consumption can affect the environment in many ways: higher levels of consumption (and therefore higher levels of production) require larger inputs of energy and material and generate larger quantities of waste byproducts. Increased extraction and exploitation of natural resources, accumulation of waste and concentration of pollutants can damage the environment and, on the long run, limit economic activity. *Rebus sic stantibus*, consumerism, a term used by sociologists to describe the effects of equating personal happiness with purchasing material possessions, can even do worse as long as it determines an increase in the amount of purchased goods.

The object of this article is to analyse the relationship between consumerism and environment. We critically review the empirical findings of the Environmental Kuznets Curve literature, according to which an inverted U-relationship between environmental degradation and economic growth is observed. In particular, we focused our attention on consumption-based approaches to the income-environment relation in order to better identify the impact of consumerism on the environment. We finally suggest a possible specification and estimation of a reduced form equation relating several impact indicator to consumption per capita.

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1 Introduction

The literature has typically expressed environmental quality as a function of average income ignoring the role consumption choices can play as a potential mediating factor between environmental degradation and economic growth. Consumption can affect the environment in many ways: higher levels of consumption (and therefore higher levels of production) require larger inputs of energy and material and generate larger quantities of waste byproducts. Increased extraction and exploitation of natural resources, accumulation of waste and concentration of pollutants can damage the environment and, on the long run, limit economic activity. Consumerism or excessive consumption can even do worse as long as it determines an increase in the amount of purchased goods. Having this in mind, the authors analysed the links between the consumption and environment using the Environmental Kuznets Curve (henceforth EKC) methodology. A consumption, rather than a production-based approach has been applied to the income environment relationship; this approach enables us to identify the different role consumption plays in developed countries and in less developed countries. In particular, the article is divided in four parts. The first part presents the theoretical underpinnings of a consumption based approach and discusses the EKC methodology and the main aspects of the literature on this subject. In the second part the relationship between environmental quality (in terms of CO_2 emissions per GDP) and consumption (in terms of consumption share of GDP) is empirically analysed in a very simple way, using consumption instead of per capita income (henceforth PCI) as our explanatory variable and focusing on the 'differences' between rich and poor countries. The third part proposes possibilities for more appropriate measures of environmental impacts and presents the results for one such measure, the ecological footprint.

2 The Environmental Kuznets Curve: a consumption based approach

The proposed analysis is most closely related to two different strands of literature. The first strand of literature analyses the relation between environmental degradation and per capita income (PCI). Within it, a first group of studies have concentrated on understanding how growth and distributional changes map into pollution reduction (Panayotou 1993, Shafik 1994, Selden and Song 1994, Grossman and Krueger 1994).

A second group of studies have attempted to understand the determinants of income elasticity of environmental quality demand and the policy implications. Initial levels of inequality, international trade, regulation, structural changes and technological progress have all been emphasised in past work as driving forces behind these differences (Torras and Boyce, 1998, Scruggs 1998, Lopez and Mitra 2000, Munasinghe 1998, Arrow et al. 1995; Panayotou, 1993).

The second strand of literature, to which this work is closely related, tries to relate consumption to environmental degradation. In particular, several studies have measured the environmental magnitude impact of anthropogenic driving forces (Ehrlich and Holdren 1971, Ekins and Jacobs 1995, Dietz and Rosa 1994, Jha and Murthy 2004), while others have shown that per capita consumption of pollution-intensive goods, particularly per capita energy use, rises with PCI (Horvath 1997, Suri and Chapman 1998). Many authors argue that a consumption-based approach is a more appropriate measure of global environmental impact (Stern et al. 1996, Ekins 1997, Rothman 1998, Suri and Chapman 1998).

2.1 Environment and Consumption

If we want to analyse the impact of human activity on the environment, the real issue is not only production but consumption and its patterns and effects. Goods and services will not be produced, bought, sold and traded across borders, unless there is a demand for them (Rothman 1998). Special attention should be paid to the demand for natural resources generated by unsustainable consumption and to the efficient use of those resources consistent with the goal of minimising depletion and reducing pollution. Although consumption patterns are very high in certain parts of the world, the basic consumer needs of a large section of humanity are not being met. This results in excessive demands and unsustainable lifestyles among the richer segments, which place immense stress on the environment.

Even technological progress can have a negative impact on the environment:

"[...] for example, although the consumption of non returnable beer bottles went up almost 600% in the period 1950-1967, actual consumption of beer per capita increased a mere five percent. Thus, the affluence gain to the beer drinker has been slight, whereas the technology chosen to package and deliver the beer, which is of no use to the consumer, has changed dramatically at the expense of the environment" (Chertow 2001, p. 18).

In a globalized market economy consumption has potentially no physical limitation and, as far as a commodity is produced, the market is able to provide it at an equilibrium price. Therefore, consumption can also determine environmental dumping as far as developed countries shift their heaviest polluting industries to less developed countries. In other words, developed countries consume pollution intensive goods produced elsewhere by developing countries.

According to the neoclassical economic theory on which a market economy is based, consumption growth is strongly related to individuals well-being. Increasing wealth at the national level brings increased utility at the individual level; people are more affluent and thus able to purchase goods and services that enhance their quality of life. On the other hand, it has been frequently observed that economic growth as measured by GDP is a poor indicator of welfare.

Among economists, growing recognition of the importance of addressing consumption has also not yet been matched by an understanding of its implications. Some economists are questioning traditional concepts of economic growth and underlining the importance of pursuing economic objectives that take account of the full value of natural resource capital. More needs to be known about the role of consumption in relation to economic growth and population dynamics in order to formulate coherent international and national policies.

In order to take into consideration all these aspects, we empirically evaluate the relationship between consumption and CO_2 emissions. Both these variables are expressed as a percentage of total GDP: in other words we examine the relationship between CO_2 emissions and consumption in terms of their share of total GDP. This is a more appropriate approach if we want to analyse the evolution of these variables over time and if we want to compare these variables between different countries. In fact, given the striking differentials in consumption behaviour between developed and developing countries, it is of particular interest to examine the 'differences' in the environment-consumption relationship between rich and poor countries.

Finally we also examined a consumption-based measure of environmental impact, the ecological footprint and its links with economic growth as measured by GDP per capita.

2.2 A brief review of the EKC hypothesis

The EKC describes a relationship that has been found empirically between per capita income and certain indicators of environmental degradation (Panayotou 1993, Shafik 1994, Selden and Song 1994, Grossman and Krueger 1994). At early stages of development, the levels of certain pollutants rise with increases in per capita income, while at higher levels of development, environmental degradation is seen to decrease with further increases in income. These results give rise to an inverted U-shaped curve relating economic growth to environmental degradation, as it is for the relationship hypothesised by Simon Kuznets (1955) between economic growth and income inequality.

Within the EKC literature, economic growth affects the environment through three different channels. Increasing output requires that more inputs and more environmental resources are used in the production process and implies more wastes and emissions by-product. Economic growth, thus, exhibits a scale effect on the environment.

On the other hand, income growth can have a positive impact on the environment through a composition effect: a change in the balance between different sectors of the economy in favour of more free pollution activities.

Finally, as a wealthy nation can afford to spend more on R&D, techno-logical progress occurs with economic growth and the dirty and obsolete technologies are replaced by upgraded new and cleaner technology, which improves environmental quality (Dinda, 2004 p. 435). This is the so-called technique effect of growth on the environment.

The findings and the assumptions of these studies have been widely criticised. In particular, several authors have underlined the limitations of the statistical relationships examined[1], the focus on pollutant emissions and concentrations and the associated lack

[1]Stern et al., 1996

of work on the depletion of resource stocks[2], the spatial and or temporal separation between many economic activities and their environmental impacts[3], the limited scope of the measures of environmental degradation[4] and the emphasis on economic growth rather than human well-being[5].

Moreover, many economists criticise these findings emphasising the fact that one of the most important factors that can explain EKC is international trade[6]. Critics claim that the observed decline in the levels of certain pollutants at high levels of income per capita can largely be attributed to the phenomenon of "environmental dumping", whereby developed countries shift their heaviest polluting industries to less developed countries.

The EKC literature summarises these effects in two related hypothesis: the 'Displacement Hypothesis' and the 'Pollution Haven Hypothesis'. Studies have shown that per capita consumption of pollution-intensive goods, particularly per capita energy use, rises with income per capita[7]. And many writers argue that a consumption-based approach is a more appropriate measure of global environmental impact[8]. This is because "most environmental degradation can be traced to the behaviour of consumers either directly, through activities like the disposal of garbage or the use of cars, or indirectly through the production activities undertaken to satisfy them" (Duchin, 1998 in Rothman, 1998 p. 183).

Significantly, levels of CO_2 emissions and municipal solid waste, both of which arise directly from consumption activities, do not conform to the EKC pattern, but instead, like per capita energy use, continue to rise with income (Rothman, 1998).

[2] Arrow et al., 1995

[3] Diwan and Shafik, 1992; Ayres, 1995; Farber, 1995; Max-Neef, 1995; Mintzer, 1995

[4] Opschoor, 1995; Karr and Thomas, 1996; O'Neill et al., 1996; Orians, 1996; Pulliam and O'Malley, 1996; Schindler, 1996

[5] Lash, 1995; Max-Neef, 1995; Pulliam and O'Malley, 1996

[6] Arrow et al., 1995; Stern et al., 1996; Suri and Chapman, 1998; Rothman, 1998 and Cole, 2003 and 2004

[7] Horvath, 1997; Suri and Chapman, 1998

[8] Stern et al., 1996; Ekins, 1997; Rothman, 1998; Suri and Chapman, 1998

3 The impact of consumption on environmental degradation

3.1 Description of the data

The analysis of consumption - CO_2 relationship covers the period ranging between 1960 and 2002, and uses a sample of 187 countries. Our proxy of environmental degradation is carbon dioxide (CO_2) emissions and comes from the World Bank, World Development Indicators (WDI 2006). The CO_2 emissions share of gross domestic product (GDP) expressed in 2000 international dollars using Purchasing Power Parity (PPP) has been used as the dependent variable. As to the explanatory variables, all the regressors used

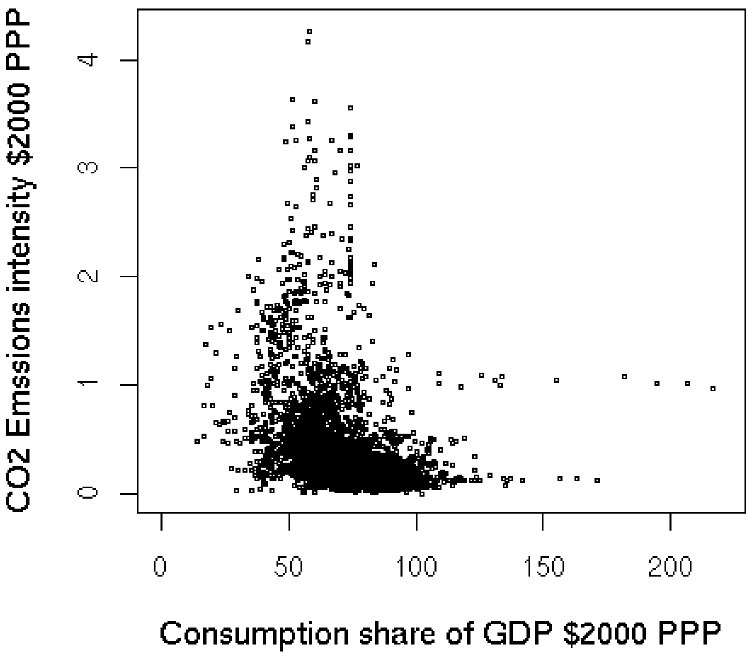

Figure 1: Complete data set

in the model come from the Penn World Tables 2006. Total consumption share of GDP and Openness are also all expressed in 2000 international dollars using PPP. As Ravallion et al. (2000, p.15) point out, "GDP according to PPP has the advantage of expressing income in comparable units in terms of living standards across countries (as compared to GDP by market exchange rates)". The complete data set of 4073 observations is presented in Figure 1.

The results presented below are based both on panel data and pooled ordinary least squares (OLS) analysis. Summary statistics are presented in tables 1 for the whole country set. Tables 2, 3 and 4 contain statistics of three groups of countries divided among income groups according to 2005 gross national income (GNI) per capita[9].

The analysis of Ecological footprint has been carried out using cross-country OLS regression for year 2003. Data for the EF come from the Living Planet Report 2006 by

[9]the distinction is based on the World Bank classification, june 2006. The groups are: 24 OECD high income countries, 46 low income countries and 94 low and lower-middle income countries

WWF International while data on GDP per capita come from the World Bank, WDI 2006 and are expressed in 2000 international dollars using PPP. Tables from 14 to 21 show the results of the regressions between the ecological footprint and GDP per capita. Summary statistics for these variables are presented in tables 5 and 6.

3.2 CO_2 and consumption

Both linear and log-linear models are examined in this work. As to the choice of the functional form, we estimated three regression models, linear, quadratic and cubic polynomial functions of consumption share of GDP. Each functional form has been estimated by least squares with and without country and time specif effects, using pooled ordinary least squares and panel data analysis examining both fixed effects (FE) and random effects (RE) specifications. However, the Hausman test rejected the null hypothesis (i.e. that individual specific effects are orthogonal to the regressors) in all functional forms. Therefore the results below will include only the FE and not the RE specification of the model. This seems to be consistent with our a priori analysis, since RE model assumes that individual specific effects are not correlated with the explanatory variables. This would lead us to believe that country specific effects such as resource endowments, regulation, public awareness and information and technology are orthogonal to a country's consumption behaviour which is rather unrealistic.

Finally, a measure of the openness of each country has been added to the model. The variable is simply the value of total trade as a percentage of GDP (exports plus imports divided by GDP).

Therefore, the FE regression model can be written as follows:

$$\begin{aligned}(CO_2/GDP)_{it} &= \beta_0 + \beta_1(CONS/GDP)_{it} + \beta_2(CONS/GDP)^2_{it} + \\ &+ \beta_3(CONS/GDP)^3_{it} + \beta_3 OPENNESS_{it} + \\ &+ \mu_i + \lambda_t + \epsilon_{it} \qquad (1)\end{aligned}$$

where 'openness' is the sum of imports and exports over GDP, μ_i measures the country fixed effect ($i = 1, \ldots N$) and λ_t the time fixed effect ($t = 1, \ldots N$). The estimation results are presented in tables 7 and 8. In general, adding a quadratic or a cubic term did not lead to a significant improvement. Starting from the highest degree polynomial and according to the significance of the parameters, the preferred specification is the cubic one. If variables are expressed in logs, results change and the preferred specification is the quadratic one. In this case an inverse U relationship between CO_2 and consumption seems to hold, although the coefficient is significant only at 10% level. Openness has always a negative sign: the higher the economic openness of a country the lower its level of emissions.

To better analyse the impact of consumerism on the environment, let us now split the database into three groups distinguishing between rich and poor countries[10]. We want to test whether the behaviour for one group is the same as for another. In fact, we expect excessive consumption to mainly caractherize western industrialised countries. If this is true, the impact of consumption on the environment should be different between low and high income countries and a comparison of the results of the samples should shed some light on this issue. The model becomes:

[10] the distinction is based on the World Bank classification, june 2006

$$
\begin{aligned}
(CO_2/GDP)_{it} &= \beta_0 + \beta_1(CONS/GDP)_{it} + \beta_2(CONS/GDP)^2_{it} + \\
&+ \beta_3(CONS/GDP)^3_{it} + \\
&+ \mu_i + \lambda_t + \epsilon_{it}
\end{aligned} \tag{2}
$$

where the variable 'openness' has been omitted. Table 9[11] summarises the results for OECD high income countries[12]. The functional form that better fits the data is the cubic one. The FE model finds that CO_2 is a cubic function of consumption share of GDP. The coefficients of the quadratic specification are also significant at 1% level. The EKC hypothesis holds.

Table 10[13] shows the results for 46 low income countries. For this group the hausmann test did not reject the null hypothesis. We then used the RE model to fit the data. However for each specification used the consumption coefficients turned out to be statistically not significant. Only the linear case shows a significant (and positive) consumption coefficient at 5% level.

Finally, tables 11, 12 and 13[14] present the results for 94 low income and lower middle income countries. Even this group of countries does not verify the EKC hypothesis. The consumption coefficient is statistically different from zero only in the linear case (in both linear and log-linear specifications).

In our opinion these findings suggest a negative effect of consumerism on the environment at the expenses of poor countries. While the EKC hypothesis is true for rich countries, evidence shows that such hypothesis does not hold for poor countries. In other words, developed countries consume pollution intensive goods produced elsewhere by developing countries.

Further investigation will be needed to examine this different impact on environmental degradation. Aggregate measures of environmental impact and resource requirements along with life quality and inequality should be used to better investigate the EKC hypothesys. For this purpose, the next part of this work concentrates on one such measure, the ecological footprint and the human development index.

3.3 The ecological footprint and GDP

In the last years, also encouraged by UNEP (particularly by the Agenda 21), the scientific community has developed several complex tools for estimating the relationship between environmental impact or resources requirement and economic activity. The ways chosen by researchers can be divided into two groups. The first one tries to modify the current accounting system to take into consideration the 'environmental work' (e.g. Green GDP (Hartwick 1990), Genuine Saving (GS) (Pearce and Atkinson 1993) and Index of Sustainable Economic Welfare (ISEW) (Daly and Cobb 1989). The second one, instead, has created a new set of indicators in an attempt to provide physically measures of environmental impact (e.g. Net Primary Productivity (Vitousek et al. 1986) (NPP), Environmental Space Schmidt - Bleek 1992 (ES), Material Intensity per Unit Service Schmidt - Bleek 1993 (MIPS), the Total Material Requirement (TMR) and Ecological Footprint (EF) methodology (Rees and Wackernagel 1996). Another way to divide the new set of

[11] the results presented include only the log specification)

[12] only the log specification of the model is reported, since results do not change with the exception of the cubic functional form whose consumption coefficients are all not statistically different from zero.

[13] the results presented include only the log specification)

[14] the results presented include only the log specification)

indicators is to distinguish between criteria underlying weak and strong sustainability (an exhaustive analysis of both criteria is contained in Neumayer, 1999).

Before commenting our estimation results, in this section we present a brief introduction to the Ecological Footprint (EF) methodology in order to better clarify the links between consumption, environment and growth.

The EF is a land-based measure, which compares the resources required to 'sustain'/produce the goods and services consumed in a country (or region, or city etc.), with the resources available in this country (or region, or city etc.). The goods, services and energy consumption per capita are translated into biological productive areas necessary to produce such amounts; in this way it is possible to measure the environmental burden of the consumers' life styles. "The ecological footprint of a specified population is the area of land and water ecosystems required to produce the resources that the population consumes, and to assimilate the wastes that the population produces, wherever on Earth the relevant land and water may be located"(Rees 2000, pp. 371).

It's clear by this definition, that the EF is a measure of environmental impact of consumption behaviours. Every good, process or service requires energy and material to be produced, consumed and waste disposed.

"The footprint of a country includes all the cropland, grazing land, forest, and fishing grounds required to produce the food, fibre, and timber it consumes, to absorb the wastes emitted in generating the energy it uses, and to provide space for its infrastructure" Living Planet Report (2006).

Rees (2000) points out that Ecological Footprint is consistent with the I = PAT identity: "the population ecological footprint (Fp) corresponds to impact (I) in the Ehrlich-Holdren formulation and is a function of population size and consumption (converted to land area). However, because consumption is a function of income (affluence) and the state of technology, Fp is an area-based analogue of PAT".

"EF is an ecological camera - each analysis provides a snapshot of a population's current demands on nature, a portrait of how things stand right now under prevailing technology and social values" Rees (2000).

The choice of Ecological Footprint index to analyse the relationship between consumption and environmental impact, has been done for tree main reasons: 1) the EF is coherent with strong sustainability approach and is expressed in physical terms; 2) it is calculated using data from the principal international institution as FAO, UNEP, Nationals Statistical Office, and the national results are updated every two years in the Leaving Planet Report; 3) finally, the EF is strictly related with the aim of this paper as it is an aggregate index of the burden of consumption on the environment.

The regression model is very simple and can be written as follows:

$$(CO_2/P)_i = \beta_0 + \beta_1 EF_i + \beta_2 EF_i^2 + \epsilon_i \tag{3}$$

where P is population and EF is the Ecological Footprint. The cross-country OLS estimation has been conducted using a dataset of 154 countries data of EF of countries, carried out by the Living Planet Report 2006 by WWF International. In particular, two type of data are examined: the aggregate value of EF for each country, to capture the overall consumption-environment relationship; moreover, the EF of a nation can be divided into its individual components (built-up land, CO_2 from fossil fuels, nuclear, fishing ground, forest, grazing land, cropland) to capture the consumption-environment relationship of each one. GDP data are expressed in 2000 international dollars using PPP and comes from the World Bank WDI indicators 2006. Due to heteroskedasticity, weighted regressions were used for the linear and quadratic forms.

Linear and log-log specification (table 14 and table 16) show a positive relationship between the two index (an increase in GDP per capita determines the growth of EF). A quadratic term and its log specification does not represent an improvement in either case, although the results are significant, the first is negative and second is positive (see tables 15 and 17).

Analysing the links between GDP and EF by its components emerge results similar to previous: the EKC hypothesis is not confirmed. At higher levels of GDP, the land (total or by components) required to sustain human consumption is higher and the turning point does not occur.

4 Conclusions

This study explored the links between environmental degradation and consumption within the framework of the environmental Kuznets curve literature.

Following Duchin (1998) most environmental degradation can be traced to the behaviour of consumers either directly, through activities like the disposal of garbage or the use of cars, or indirectly through the production activities undertaken to satisfy them. This is why we believe that a consumption-based approach is a more appropriate measure of global environmental impact than PCI. It enables us to evaluate not only the burden of human activity on the environment but also how shifts in consumption patterns and consumers' life styles can stress or improve such burden.

Although the empirical analysis is very simple, the results confirm the particular role played by consumption. Also, they show that estimating an EKC using consumption and focusing on the differences between high income OECD countries and low income countries yields different results than when the EKC is estimated using data for the world as a whole. In particular, our findings show that FE models on panel data achieve different results if we compare rich and poor countries. While for the latter an EKC relationship between consumption and CO_2 emissions seems to hold, this is not true for the former. The absence of an inverted-U shape relationship is confirmed if we examine the link between Ecological Footprint and GDP per capita in the cross-country analysis.

A possible explanation of these different results is the 'environmental dumping' activity of rich countries towards poor countries. Goods and services will not be produced, bought, sold and traded across borders, unless there is a demand for them (Rothman 1998). Special attention should be paid to the demand for natural resources generated by unsustainable consumption and to the efficient use of those resources consistent with the goal of minimising depletion and reducing pollution.

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5 Appendix

Table 1: **summary statistics (187 countries in 1960-2002)**

variable	**obs**	**mean**	**sd**	**min**	**max**
CO_2 (% GDP)	4073.00	0.49	0.50	0.00	4.27
consumption (% GDP)	6648.00	69.65	21.26	7.46	473.72
openness (% GDP)	6658.00	75.26	53.99	2.00	986.45

Table 2: **summary statistics (24 high income OECD countries, 1960-2002)**

variable	**obs**	**mean**	**sd**	**min**	**max**
CO_2 (% GDP)	657.00	0.47	0.20	0.18	1.43
consumption (% GDP)	1070.00	58.52	5.75	41.10	74.18
openness	1070.00	55.59	42.56	4.75	286.48

Table 3: **summary statistics (46 low income countries, 1960-2002)**

variable	**obs**	**mean**	**sd**	**min**	**max**
CO_2 (% GDP)	1120.00	0.31	0.53	0.00	3.64
consumption (% GDP)	1930.00	82.67	22.77	30.34	473.72
openness	1930.00	59.84	53.02	2.00	986.45

Table 4: **summary statistics (94 low and lower-middle income countries, 1960-2002)**

variable	obs	mean	sd	min	max
CO_2 (% GDP)	2238.00	0.42	0.54	0.00	3.64
consumption (% GDP)	3749.00	77.80	21.75	22.99	473.72

Table 5: **summary statistics EF and GDP (154 countries, 2003)**

variable	obs	mean	sd	min	max
footprint (EF)	154.00	2.36	2.01	0.10	11.90
gdp per capita	144.00	8484.95	9250.33	568.99	35373.12

Table 6: **summary statistics EF and HDI (145 countries, 2003)**

variable	obs	mean	sd	min	max
footprint (EF)	145.00	2.43	2.04	0.50	11.90
hdi	145.00	0.70	0.19	0.31	0.96

Table 7: **estimation results: variables in levels**

variable	linear	quadratic	cubic
consumption	0.0021^{**}(5.34)	0.0048^{**}(4.40)	0.0187^{**}(7.10)
$(consumption)^2$		-0.00001^{**}(-2.64)	-0.0001^{**}(-6.23)
$(consumption)^3$			$5.21\times10^{-7**}$(5.87)
openness	-0.0011^{**}(-8.20)	-0.0009^{**}(-6.87)	-0.0009^{**}(-6.85)
intercept	0.4091^{**}(14.86)	0.2962^{**}(5.83)	-0.0602 (-0.76)
$adj.R^2$ (overall)	0.11	0.12	0.09

Significance levels : † : 10% $*$: 5% $**$: 1%

Table 8: **estimation results: variables in logs**

variable	linear	quadratic	cubic
$\ln(consumption)$	0.3557^{**}(5.34)	1.165 **(2.61)	-1.4160 (-0.45)
$(\ln consumption)^2$		$-0.1008^{\dagger}$(-1.82)	0.5548 (0.69)
$(\ln consumption)^3$			-0.0548 (-0.82)
$\ln(openness)$	-0.0813^{**}(-8.20)	-0.0743^{**}(-3.94)	-0.0724^{**}(-3.81)
intercept	-2.3149^{**}(14.86)	-3.9598^{**}(-4.29)	-0.6245 (-0.15)
$adj.R^2$ (overall)	0.20	0.19	0.19

Significance levels : † : 10% $*$: 5% $**$: 1%

Table 9: **estimation results: high income OECD countries, variables in logs**

variable	linear	quadratic	cubic
$\ln(consumption)$	2.176^{**}(16.61)	33.264^{**}(6.51)	-721.296^{**}(-5.01)
$(\ln consumption)^2$		-3.852^{**}(-6.09)	184.114^{**}(5.14)
$(\ln consumption)^3$			-15.594^{**}(-5.25)
intercept	-9.652^{**}(-18.16)	-72.32^{**}(-7.02)	936.454^{**}(4.86)
$adj.R^2$ (within)	0.30	0.34	0.37

Significance levels : † : 10% $*$: 5% $**$: 1%

Table 10: **estimation results: low income countries, variables in logs**

variable	linear	quadratic	cubic
$\ln(consumption)$	0.2056^{*}(2.51)	0.101 (0.08)	5.619 (0.36)
$(\ln consumption)^2$		0.0118 (0.08)	-1.283 (-0.35)
$(\ln consumption)^3$			0.1009 (0.35)
intercept	-2.668^{**}(0.379)	-2.442 (-0.86)	-10.232 (-0.46)
$adj.R^2$ (overall)	0.10	0.10	0.09

Significance levels : † : 10% $*$: 5% $**$: 1%

Table 11: **Estimation results 94 low and lower middle income countries: Linear**

Variable	Coefficient	(Std. Err.)
$\ln(consumption)$	0.314^{**}	(0.069)
Intercept	-2.846^{**}	(0.298)

Significance levels : † : 10% $*$: 5% $**$: 1%

Table 12: **Estimation results 94 low and lower-middle income countries: Quadratic**

Variable	Coefficient	(Std. Err.)
$\ln(consumption)$	1.879(1.117)	
$(\ln consumption)^2$	-0.184(0.131)	
Intercept	-6.167(2.384)	

Significance levels : † : 10% $*$: 5% $**$: 1%

Table 13: **Estimation results 94 low and lower-middle income countries: Cubic**

Variable	Coefficient	(Std. Err.)
$\ln(consumption)$	14.753(14.311)	
$(\ln consumption)^2$	-3.224(3.372)	
$(\ln consumption)^3$	0.238(0.264)	
Intercept	-24.250(20.180)	

Significance levels : † : 10% $*$: 5% $**$: 1%

Table 14: **EF vs. GDP per capita: Linear functional form**

Variable	**Coefficient**	**(Std. Err.)**
(gdp/P)	0.000209^{**}	(0.000)
Intercept	0.640^{**}	(0.051)

Significance levels : $\dagger$: 10% $*$: 5% $**$: 1%

Table 15: **EF vs. GDP per capita: Quadratic functional form**

Variable	**Coefficient**	**(Std. Err.)**
(gdp/P)	0.0002631^{**}	(.0000273)
$(gdp/P)^2$	$-2.35e\text{-}09^{**}$	(1.09e-09)
Intercept	0.55504^{**}	(0.064)

Significance levels : $\dagger$: 10% $*$: 5% $**$: 1%

Table 16: **EF vs. GDP per capita: Log-linear functional form**

Variable	**Coefficient**	**(Std. Err.)**
$\ln(gdp/P)$	0.4848^{**}	(0.029)
Intercept	-3.573^{**}	(0.217)

Significance levels : $\dagger$: 10% $*$: 5% $**$: 1%

Table 17: **EF vs. GDP per capita: Log-quadratic functional form**

Variable	**Coefficient**	**(Std. Err.)**
$\ln(gdp/P)$	-0.888^{*}	(0.404)
$(\ln(gdp/P))^2$	0.0876^{**}	(0.025)
Intercept	1.719	(1.567)

Significance levels : $\dagger$: 10% $*$: 5% $**$: 1%